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Is the Shroud of Turin in relation to the Old Jerusalem historical earthquake?

Alberto Carpinteri, Giuseppe Lacidogna, Oscar Borla

Politecnico di Torino, Department of Structural, Geotechnical and Building Engineering

NEUTRON EMISSION FROM FRACTURE AND EARTHQUAKES

NEUTRON EMISSION FROM EARTHQUAKES

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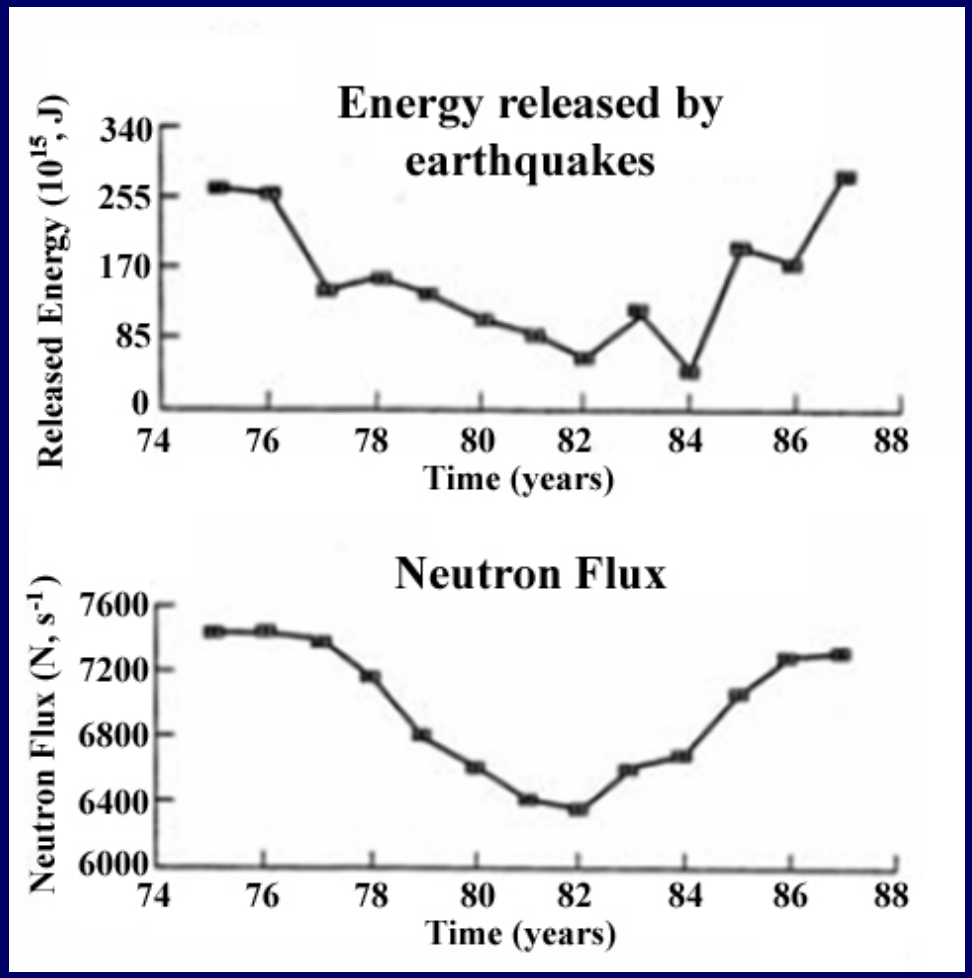
(Continued)

As reported in the literature, an average **thermal neutron flux** up to 10^0 cm^{-2} s^{-1} **(10^3 times the background level)** was detected in correspondence to earthquakes with a magnitude of the 4th degree in Richter Scale (Volodichev N.N., et al. (1999)).

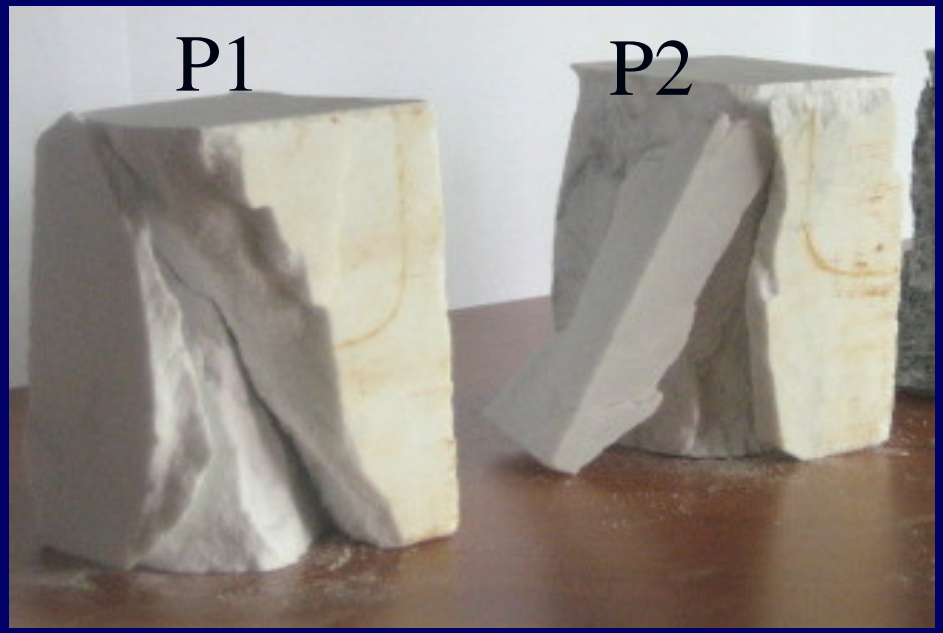


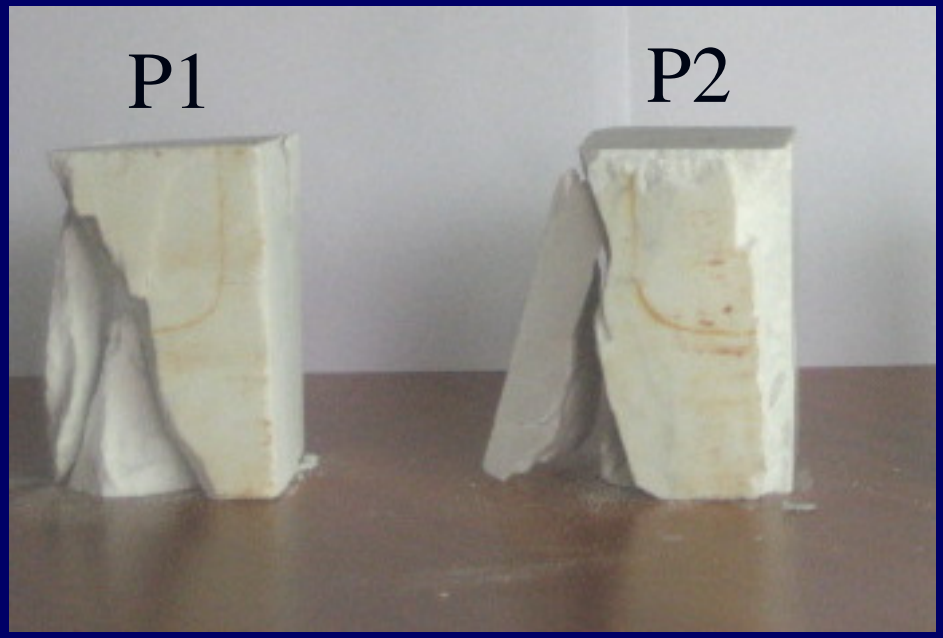
Global seismic activity and neutron flux measurements in the period 1975-1987. **Laboratory of Geophysical Precursors**, Oblast' Murmansk, Apatity, **Kola Peninsula**, Russia (Sobolev et al. 1998).

NEUTRON EMISSION FROM ROCK SPECIMENS

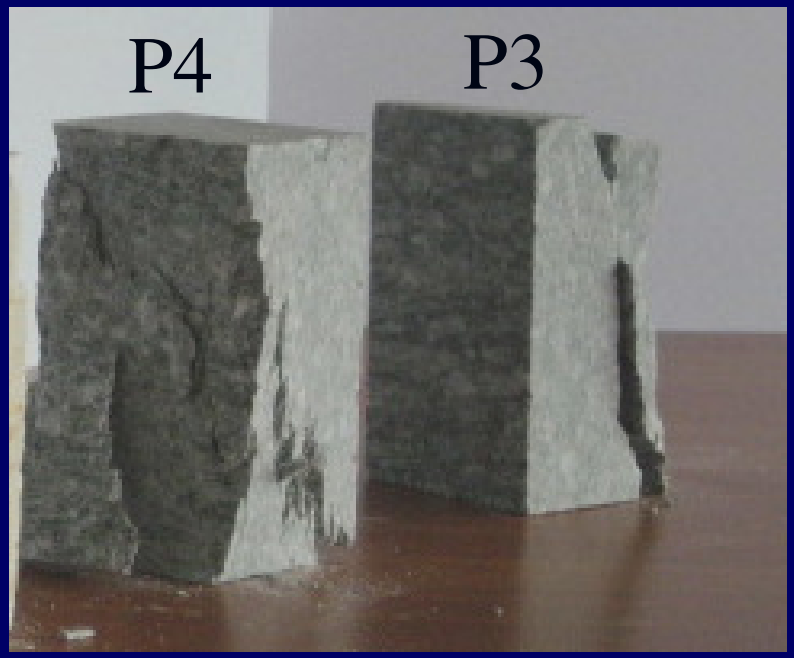
During a preliminary experimental analysis <u>four rock specimens</u> were used:

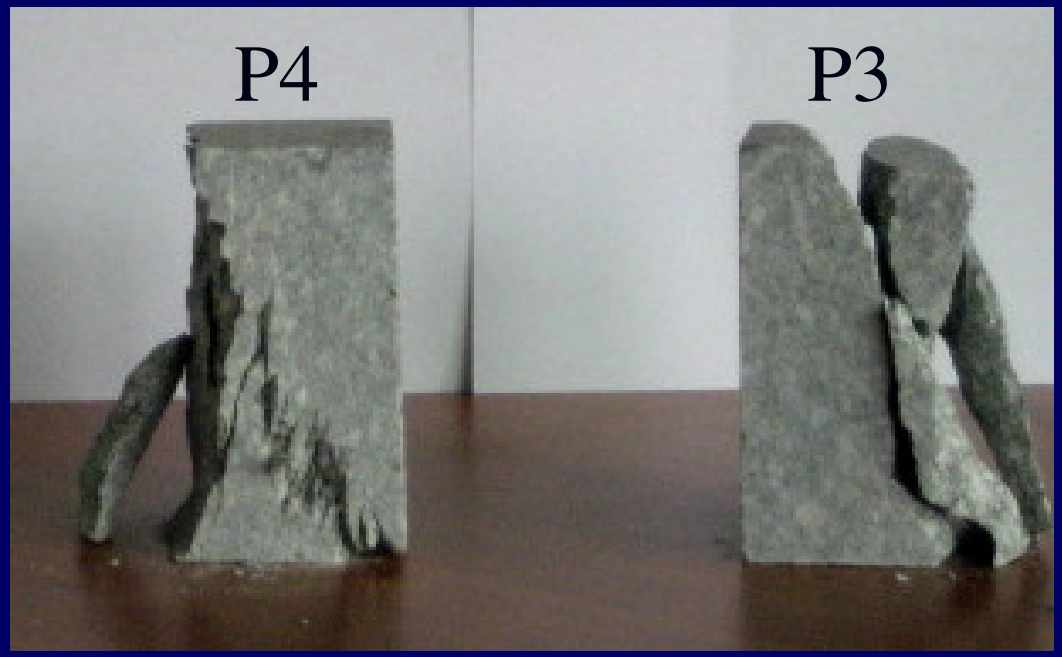
- two made of **<u>Carrara marble</u>**, specimens P1 and P2;
- two made of **<u>Luserna granite</u>**, specimens P3 and P4;
- all of them measuring **<u>6x6x10 cm^3</u>**.





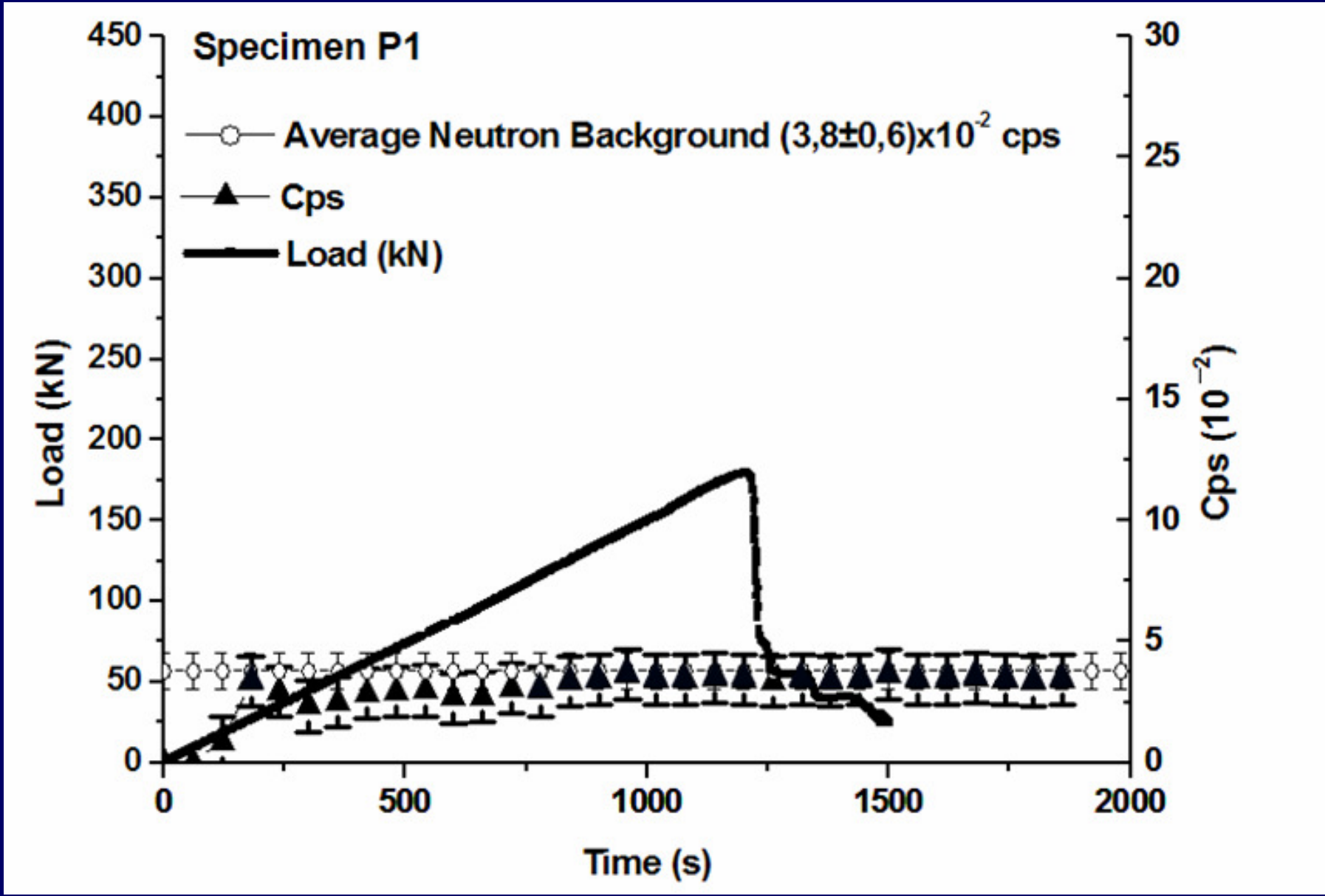
Specimens P1 and P2 in Carrara marble following compression failure.





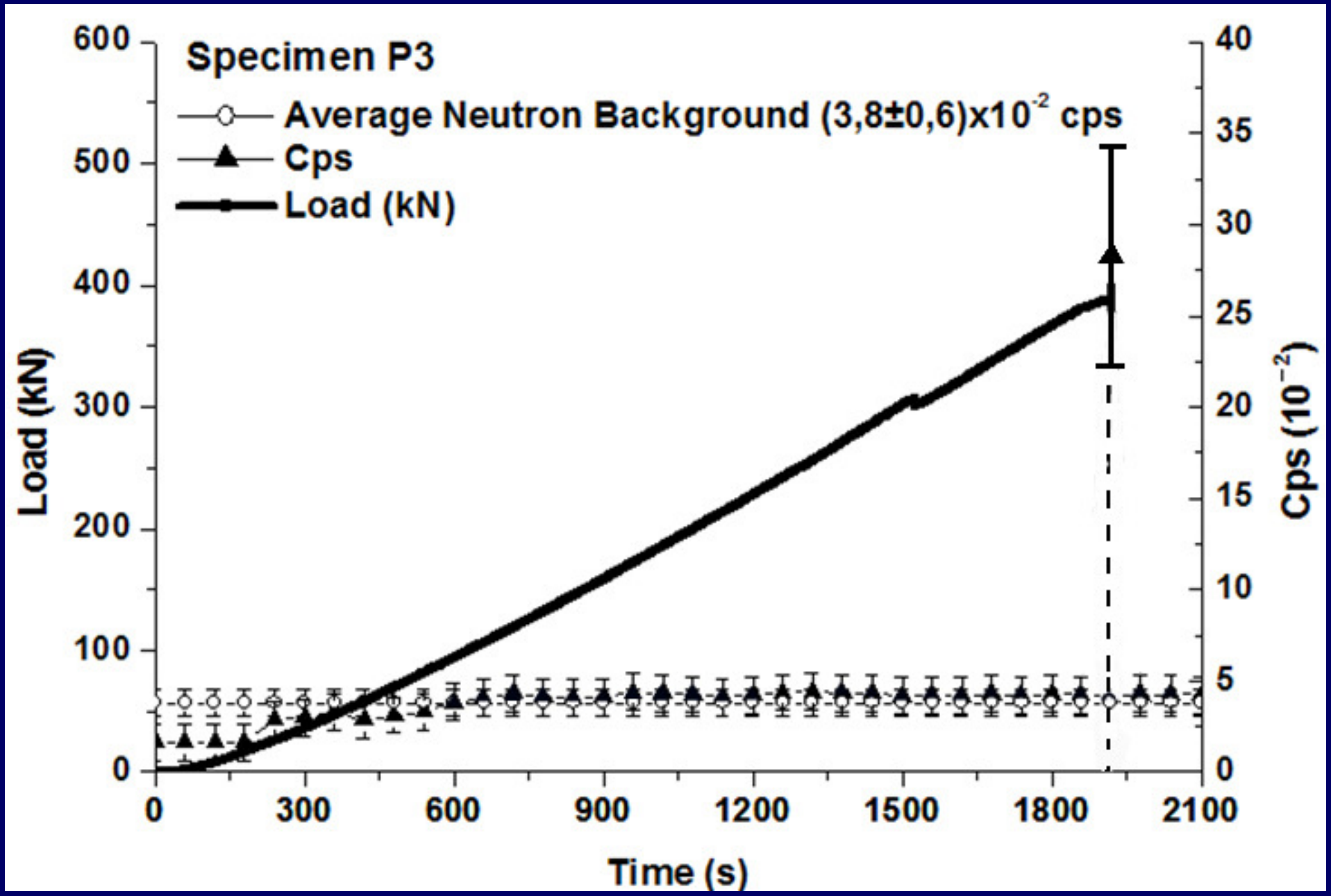
Specimens P3 e P4 in Luserna granite following compression failure.

Brittle Fracture Experiment on Carrara Marble specimen



Load vs. time and cps curve for P1 test specimen of Carrara marble.

Brittle Fracture Experiment on granite specimen

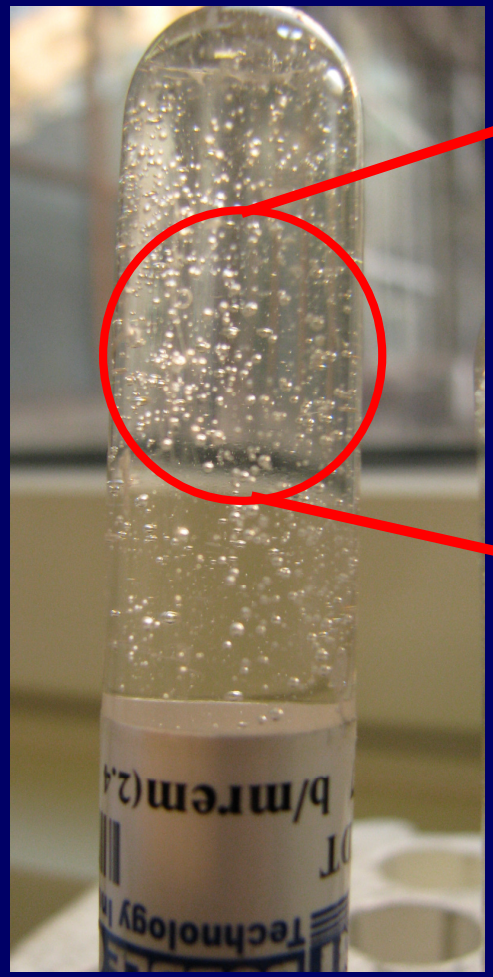


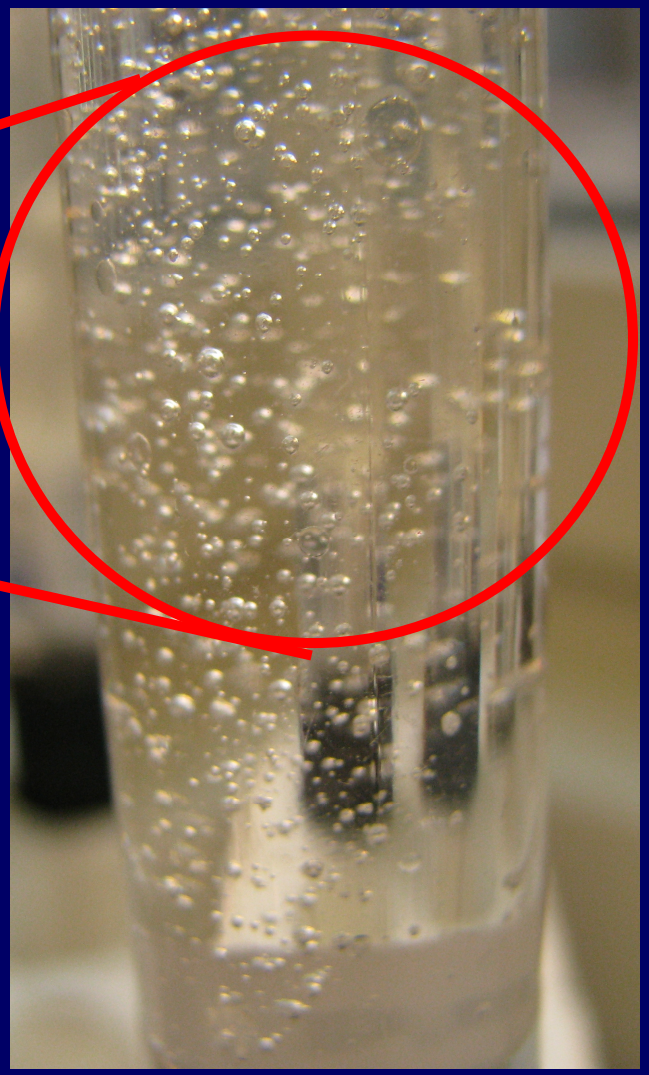
Load vs. time and cps curve for P3 test specimen of granite.

NEUTRON EMISSION FROM CAVITATION IN LIQUIDS AND FRACTURE IN SOLIDS

MATERIAL	NEUTRON EMISSION
LIQUIDS – Cavitation	
Iron chloride	→ up to 2.5 times the Background Level
SOLIDS – Fracture	
Steel	→ up to 2.5 times the Background Level
Granite (Fe ~ 1.5%)	→ up to 10^1 times the Background Level
Basalt (Fe ~ 15%)	→ up to 10^2 times the Background Level
Magnetite (Fe ~ 75%)	→ up to 10^3 times the Background Level
Marble	→ Background Level

Cyclic Loading Experiments on Basaltic Rocks





The equivalent neutron dose, at the end of the test on basaltic rock, was 2.62 ± 0,53 μSv/h (Average Background Dose = 41.95 ± 0,85 nSv/h).

$$\frac{\text{Effective Neutron Dose}}{\text{Average Background Dose}} \cong 50$$

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Neutron production from the fracture of piezoelectric rocks

A Widom[1], J Swain[1] and Y N Srivastava[2]

[1] Physics Department, Northeastern University, Boston MA, USA
[2] Department of Physics & INFN, University of Perugia, Perugia, Italy

E-mail: John.Swain@cern.ch

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Abstract

A theoretical explanation is provided for the experimental evidence that fracturing piezoelectric rocks produces neutrons. The elastic energy micro-crack production ultimately yields the macroscopic fracture. The mechanical energy is converted by the piezoelectric effect into electric field energy. The electric field energy decays via radio frequency (microwave) electric field oscillations. The radio frequency electric fields accelerate the condensed matter electrons which then collide with protons producing neutrons and neutrinos.

Photo-Disintegration of the Iron Nucleus in Fractured Magnetite Rocks with Magnetostriction

A. Widom and J. Swain
Physics Department, Northeastern University, Boston MA USA

Y.N. Srivastava
Physics Department & INFN, University of Perugia, Perugia IT

There has been considerable interest in recent experiments on iron nuclear disintegrations observed when rocks containing such nuclei are crushed and fractured. The resulting nuclear transmutations are particularly strong for the case of magnetite rocks, i.e. loadstones. We argue that the fission of the iron nucleus is a consequence of photo-disintegration. The electro-strong coupling between electromagnetic fields and nuclear giant dipole resonances are central for producing observed nuclear reactions. The large electron energies produced during the fracture of piezomagnetic rocks are closely analogous to the previously discussed case of the fracture of piezoelectric rocks. In both cases electro-weak interactions can produce neutrons and neutrinos from energetic protons and electrons thus inducing nuclear transmutations. The electro-strong condensed matter coupling discussed herein represents new many body collective nuclear photo-disintegration effects.

PACS numbers: 62.20.mm, 81.40.Np, 03.75.Be, 14.20.Dh

EVIDENCE FOR PHOTOFISSION OF IRON*

C. B. Fulmer, I. R. Williams, and T. H. Handley
Oak Ridge National Laboratory, Oak Ridge, Tennessee

and

G. F. Dell and L. N. Blumberg†
Cambridge Electron Accelerator, Cambridge, Massachusetts
(Received 4 August 1967)

Studies of proton-induced reactions in the GeV energy region[1,2] have given evidence that fission occurs in nuclei at least as light as silver. It has been pointed out that any nucleus can be made to undergo fission provided it is supplied with sufficient excitation energy.[3,4] In this note we present evidence of photofission in iron foils that were bombarded with high-energy electrons.

that were bombarded with 3-GeV electrons an appreciable yield of ^{7}Be was observed.[5] Careful examination of the gamma spectra obtained from the iron targets yielded no evidence for ^{7}Be. A radiochemical separation also yielded no evidence for ^{7}Be in an iron foil that was bombarded with 3-GeV electrons. Studies of proton- and alpha-induced reactions[6] have shown that emission of ^{7}Be is enhanced by rotation-

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Fission of Medium Weight Elements*

ROGER E. BATZEL AND GLENN T. SEABORG
Radiation Laboratory and Department of Chemistry, University of California, Berkeley, California
(Received February 19, 1951)

Evidence is presented here which indicates that large fragments (much larger than alpha-particles) are emitted among the competitive products of transmutation throughout the entire range of atomic numbers of the elements. Threshold considerations for the observed nuclear reactions show that the reactions are observed with small cross sections well below the threshold for spallation reactions in which the maximum number of alpha-particles are considered as being emitted from the excited nucleus. The calculated thresholds include the mass difference between the reactants and the products and the excitation energy which the product particles or fragments must have in order to pass over the coulombic barrier. Preliminary experiments on the ranges of recoil fragments from copper irradiated with 340-Mev protons give additional evidence for the emission of heavy fragments. It is suggested that the term "fission" is proper for such reactions, throughout the entire range of atomic numbers, in which the nucleus is split essentially into pieces of comparable weight.

I. INTRODUCTION

THE fission reaction has been observed with high energy accelerator projectiles for elements as light as tantalum,[1] but has not been reported for medium weight elements. Evidence is presented here for occurrence of reactions which are probably most

an example, the extreme reaction $Cu^{63}+p\rightarrow Cl^{38}+Al^{25}+n$, which is energetically most economical but still endoergic, has a threshold of about 50 Mev.

This result made it seem worthwhile to investigate another such reaction in copper and to extend the threshold studies to other elements in the middle portion

SHROUD IMAGE FORMATION AND DATING EVALUATION

HYSTORICAL DEBATE

After the first photographs of the Shroud, taken by **Mr. Secondo Pia** during the Exposition of **1898** in Turin, a widespread interest has been generated among scientists and curious **to explain the image formation and to evaluate its dating.**

The image seems to be formed with lights and shades reversed in **a sort of negative photography. Vignon** *(M. Vignon's researches and the "Holy Shroud". Nature 66, 13-14 (**1902**))* asserts that the image was produced by **radiographic action** from the body which, according to ancient texts, was wrapped in a shroud impregnated with a mixture of oil and aloes.

Further studies have focused on the Shroud dating, especially since **1986**, when the Roman Catholic Church declared that pieces of the Shroud of Turin had been sent to **seven laboratories around the world, later reduced to only three, for radiocarbon dating.**

In **1988** Dickman *(Dickman S. Shroud a good forgery. Nature 335, 663 (1988))* declares that the **official carbon dating results** for the Turin Shroud were released in Zurich. The results provide evidence that **the linen of the Shroud of Turin should be medieval, dated between 1260 and 1390.**

THE NEUTRON IRRADIATION HYPOTHESIS

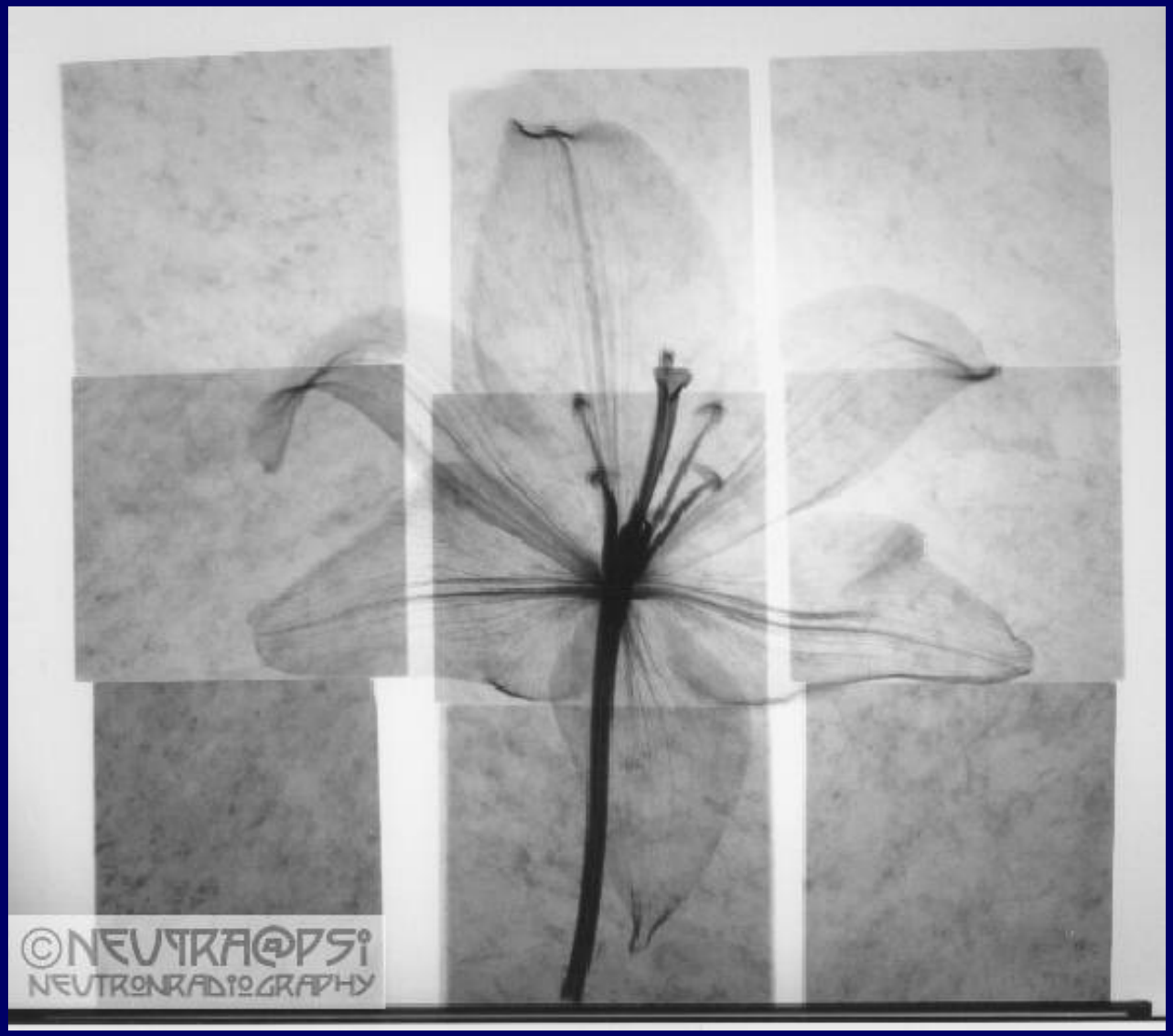
Phillips in the paper "Shroud irradiated with neutrons?" *(Nature 337, 594 (**1989**))* supposes that the Shroud may have been irradiated with neutrons which would have changed some of the nuclei to different isotopes by neutron capture.

In particular, Phillips assumes that some C_6^{14} nuclei could have generated from C_6^{13}, and that an integrated flux of **2×10^{16}** thermal neutrons cm^{-2} could have produced an apparent carbon-dated age of just 670 years.

However, **Hedges** *(Hedges, R.E.M. Replies to: Shroud irradiated with neutrons?. Nature **337**, 594 (**1989**))* asserts that the integrated flux proposed by Phillips is excessively high and **« including the neutron capture by nitrogen in the cloth, an integrated thermal neutron flux of 2×10^{13} would be appropriate »** for the apparent radiocarbon dating of the Shroud.

Also **Rinaudo** *(Rinaudo, J.B. Image formation on the Shroud of Turin explained by a protonic model affecting radiocarbon dating. III Congresso Internazionale di Studi sulla Sindone, Torino, Italy, 5-7 June **1998**)* evaluates that simultaneous fluxes of protons and neutrons could explain at the same time the imprint on the cloth (by protons) and the 13-century slip of time of the nuclei (by neutrons).

NEUTRON EFFECTS ON LINEN FIBRES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NEUTRONRADIOGRAPHY

Neutron imaging is a X-ray-like radiography technique. The most important detection reaction, used in neutron imaging, for thermal neutrons is:

$$\mathrm{Gd}_{64}^{157} + \mathrm{n}_{0}^{1} \rightarrow \mathrm{Gd}_{64}^{158} + \text{gamma} + \text{conversion electrons (8.5 MeV)}$$

in which a converter material (i.e. gadolinium) captures neutrons and emits secondary charged particles that reproduce the irradiated object on Neutron Imaging Plates (NIP). Usually, a **thermal neutron flux of 10^5 neutrons cm^{-2} s^{-1}** is employed, with an irradiation time of few minutes for a total **integrated flux of 10^8 neutrons cm^{-2}**, with typical NIP enriched for more than 20% in weight of Gd_2O_3.

The most important nuclear reaction of thermal neutrons on nitrogen nuclei is represented by:

$$\mathrm{N}_{7}^{14} + \mathrm{n}_{0}^{1} \rightarrow \mathrm{C}_{6}^{14} + \mathrm{H}_{1}^{1}$$

that is liable of radiocarbon formation also in the atmosphere.

OLD JERUSALEM HISTORICAL EARTHQUAKE

OLD DOCUMENTS VERSUS MODERN DATABASES

Scientific data of the historical earthquake occurred in 33 A.D. in Jerusalem are mentioned in the "Significant Earthquake Database" of the American Scientific Agency NOAA (National Oceanic and Atmospheric Administration). In this database the "Old Jerusalem" earthquake is classified as an average devastating seismic event.

Moreover, if we assign the image imprinted on the Shroud to the Man who died during the Passover of 33 A.D., there are at least **three documents in the literature attesting the occurrence of the disastrous earthquakes during that event.**

•A historian named **Thallos** has left mention of events occurred on the Christ's death day: the darkening of the sky and the happening of an earthquake *(Rigg, H. Thallus: The Samaritan?. Harvard Theological Review 34, 111-119 (1941))* ;

•**Matthew** wrote that there was a strong earthquake at the moment of Christ's death: «When the centurion and those who were with him, keeping watch over Jesus, saw the earthquake and what took place, they were filled with awe and said, "Truly this was the Son of God!".» *(Matthew 27: 54) ;*

•That event is also mentioned by **Dante Alighieri**, XXI Canto, Inferno, as the most violent earthquake that had ever shaken the Earth *(Inferno, XXI Canto:106-114).*

ENERGY RELEASE INCREASE BY 10^2 FOR EACH RICHTER SCALE DEGREE

Taking into account the historical sources attesting the occurrence of a disastrous earthquake in 33 A.D., and **assuming a hypothetical magnitude of the 9th degree in the Richter scale** *(Ambraseys, N., "Historical earthquakes in Jerusalem – A methodological discussion", Journal of Seismology 9: 329-340 (2005))*, it is possible to provide an evaluation of the consequent neutron flux.

The Richter scale is logarithmic (base 10). This means that, for each degree increasing on the Richter scale, the amplitude and the acceleration of the ground motion recorded by a seismograph increase by 10 times.

From a displacement or acceleration viewpoint, an earthquake of the 9th degree in the Richter scale is 10^5 times more intense than a 4th magnitude degree. On the other hand, from the energy viewpoint, it is 10^{10} times more intense than the same reference event.

NEUTRON FLUX PROPORTIONAL TO ENERGY RELEASE

Assuming a typical environmental thermal neutron flux background of about 10^{-3} cm^{-2} s^{-1} at the sea level, in correspondence of appreciable **earthquakes with a magnitude of the 4th degree, an average thermal neutron flux up to 10^{0} cm^{-2} s^{-1}** should be detected, that is 1000 times higher than the natural background *(Antonova, V. P., Volodichev, N.N., Kryukov, S.V., Chubenko, A. P. & Shchepetov, A.L. Results of Detecting Thermal Neutrons at Tien Shan High Altitude Station. Geomagnetism and Aeronomy **49**, 761-767 (2009)* and *Pfotzer, G. & Regener, E. Vertical intensity of cosmic rays by threefold coincidence in the stratosphere. Nature **136**, 718-719 (1935).*

Thus, an earthquake of the **9th degree in the Richter scale** could provide a **thermal neutron flux ranging around 10^{10} cm^{-2} s^{-1}, if proportionality between released energy and neutron flux holds.** A similar event could have produced chemical and/or nuclear reactions, contributing both to the image formation and to the increment in the linen fibres of the Shroud, if it had lasted for at least 15 minutes.

In this way, an appropriate **integrated thermal neutron flux of about 10^{13} neutrons cm^{-2} is obtained, as assumed by Hedges** *(Hedges, R.E.M. Replies to: Shroud irradiated with neutrons?. Nature **337**, 594 (1989)).*